

What we claim is:

1. Apparatus for processing image data comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may operate asynchronously;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

said scheduling instructions include steps of:

(a) identifying existing conditions of said graphics rendering process;

(b) comparing required conditions of graphics requests from a plurality of said players with said existing conditions; and

(c) scheduling a preferred graphics request in response to comparisons performed at step (b).

2. Apparatus for processing image data comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and
5 processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to
10 instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may have a different frame rate;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player, in order to draw
15 frames of scene data for the player at its respective frame rate ; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process;
20 wherein

said scheduling instructions include steps of:

- (a) identifying existing conditions of said graphics rendering process;
- (b) comparing said existing conditions with required conditions of
25 player graphics requests;
- (c) selecting a preferred graphics request in response to said comparison of required conditions;

(d) scheduling a preferred player by processing the due time of said preferred graphics requests of the players with said required and existing conditions; and

5 (e) transferring a preferred graphics request from said scheduled player to said graphics rendering process.

3. Apparatus according to claim 1 or claim 2, wherein said players include a player for drawing user interface widgets.

10 4. Apparatus according to claim 2, wherein said due time for a frame is defined by its frame rate.

15 5. Apparatus according to claim 2, wherein said graphics rendering process is multi-threaded.

6. Apparatus according to claim 5, wherein individual threads in said graphics rendering process are allocated graphics requests in response to a load balancing strategy.

20 7. Apparatus according to claim 2, wherein said selecting step is performed so as to minimise the required change of state in said graphics rendering process.

25 8. Apparatus according to claim 2, wherein said scheduling instructions include frame control strategy instructions and or data specific to a hardware implementation of the graphics rendering process.

9. Apparatus for processing image data comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and
5 processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at
10 least one pointer to said player instructions, such that each player may have a different frame rate;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player, in order to draw
15 frames of scene data for the player at its respective frame rate; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

- 20 (a) each frame for a player is defined by multiple graphics requests;
(b) graphics requests are selected from players so as to minimise state changes while switching the rendering process from player to player; and
(c) players running at higher frame rates have their graphics
25 requests selected more frequently than those running at lower frame rates.

10. Apparatus according to claim 9, wherein said scheduling

instructions include instructions such that each player is allocated a strategy for prioritising its graphics requests.

5 11. A method of processing image data in an image processing system comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

10 said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may operate asynchronously;

15 said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player; and

20 said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

 said scheduling instructions facilitate steps of:

- 25 (a) identifying existing conditions of said graphics rendering process;
- (b) comparing required conditions of graphics requests from a plurality of said players with said existing conditions; and
- (c) scheduling a preferred graphics request in response to

comparisons performed at step (b).

12. A method of processing image data in an image processing system comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may have a different frame rate;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player, in order to draw frames of scene data for the player at its respective frame rate ; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

said scheduling instructions facilitate steps of:

(a) identifying existing conditions of said graphics rendering process;

(b) comparing said existing conditions with required conditions of player graphics requests;

(c) selecting a preferred graphics request in response to said

comparison of required conditions;

(d) scheduling a preferred player by processing the due time of said preferred graphics requests of the players with said required and existing conditions; and

5 (e) transferring a preferred graphics request from said scheduled player to said graphics rendering process.

10 **13.** A method according to claim **11** or claim **12**, wherein said players include a player that draws user interface widgets.

14. A method according to claim **12**, wherein said due time for a frame is defined by its frame rate.

15 **15.** A method according to claim **12**, wherein said graphics rendering process is multi-threaded.

16. A method according to claim **15**, wherein individual threads in said graphics rendering process are allocated graphics requests in response to a load balancing strategy.

20 **17.** A method according to claim **12**, wherein said selecting step is performed so as to minimise the required change of state in said graphics rendering process.

25 **18.** A method according to claim **12**, wherein said scheduling instructions include frame control strategy instructions and or data specific to a hardware implementation of the graphics rendering process.

19. A method of processing image data in an image processing system comprising storage means for storing image processing instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may have a different frame rate;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player, in order to draw frames of scene data for the player at its respective frame rate; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

- (a) each frame for a player is defined by multiple graphics requests;
- (b) graphics requests are selected from players so as to minimise state changes while switching the rendering process from player to player; and
- (c) players running at higher frame rates have their graphics requests selected more frequently than those running at lower frame rates.

20. A method according to claim **19**, wherein each said player is allocated a strategy for prioritising its graphics requests.

21. A computer-readable medium having computer-readable instructions executable by a computer configurable for image processing, said computer including storage means for storing image processing instructions derived from said computer-executable instructions, memory means for storing said image processing instructions during their execution and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may operate asynchronously;

said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response to the scene data associated with each respective player; and

said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process; wherein

said scheduling instructions include steps of:

- (a) identifying existing conditions of said graphics rendering process;
- (b) comparing required conditions of graphics requests from a

plurality of said players with said existing conditions; and

(c) scheduling a preferred graphics request in response to comparisons performed at step (b).

5 **22.** A computer-readable medium having computer-readable instructions executable by a computer configurable for image processing, said computer including storage means for storing image processing instructions derived from said computer-executable instructions, memory means for storing said image processing instructions during their execution
10 and image data in the form of scene data for one or a plurality of animated scenes, and processing means;

 said image processing instructions include player instructions for generating graphics requests to render an animated scene, and said processing means is configurable by said image processing instructions to
15 instantiate a plurality of players, each of which comprises player data and at least one pointer to said player instructions, such that each player may have a different frame rate;

 said processing means is configurable by said player instructions such that graphics requests are generated by each said player in response
20 to the scene data associated with each respective player, in order to draw frames of scene data for the player at its respective frame rate ; and

 said image processing instructions include scheduling instructions such that said processing means is configurable to supply graphics requests generated by said players to a graphics rendering process;
25 wherein

 said scheduling instructions include steps of:

(a) identifying existing conditions of said graphics rendering

process;

(b) comparing said existing conditions with required conditions of player graphics requests;

5 (c) selecting a preferred graphics request in response to said comparison of required conditions;

(d) scheduling a preferred player by processing the due time of said preferred graphics requests of the players with said required and existing conditions; and

10 (e) transferring a preferred graphics request from said scheduled player to said graphics rendering process.

15 **23.** A computer-readable medium according to claim **21** or claim **22**, wherein said players include a player for drawing user interface widgets.

24. A computer-readable medium according to claim **22**, wherein said due time for a frame is defined by its frame rate.

20 **25.** A computer-readable medium according to claim **22**, wherein said graphics rendering process is multi-threaded.

26. A computer-readable medium according to claim **25**, wherein individual threads in said graphics rendering process are allocated graphics requests in response to a load balancing strategy.

25 **27.** A computer-readable medium according to claim **22**, wherein said selecting step is performed so as to minimise the required change of

state in said graphics rendering process.

5 **28.** A computer-readable medium according to claim **22**, wherein
said scheduling instructions include frame control strategy instructions and
or data specific to a hardware implementation of the graphics rendering
process.

10 **29.** A computer-readable medium having computer-readable
instructions executable by a computer configurable for image processing,
said computer including storage means for storing image processing
instructions derived from said computer-executable instructions, memory
means for storing said image processing instructions during their execution
and image data in the form of scene data for one or a plurality of animated
scenes, and processing means;

15 said image processing instructions include player instructions for
generating graphics requests to render an animated scene, and said
processing means is configurable by said image processing instructions to
instantiate a plurality of players, each of which comprises player data and at
least one pointer to said player instructions, such that each player may
20 have a different frame rate;

 said processing means is configurable by said player instructions
such that graphics requests are generated by each said player in response
to the scene data associated with each respective player, in order to draw
frames of scene data for the player at its respective frame rate; and

25 said image processing instructions include scheduling instructions
such that said processing means is configurable to supply graphics
requests generated by said players to a graphics rendering process;

wherein

(a) each frame for a player is defined by multiple graphics requests;
(b) graphics requests are selected from players so as to minimise
state changes while switching the rendering process from player to player;

5 and

(c) players running at higher frame rates have their graphics
requests selected more frequently than those running at lower frame rates.

10 **30.** A computer-readable medium according to claim **29**, wherein
said scheduling instructions include instructions such that each player is
allocated a strategy for prioritising its graphics requests.